

**The effectiveness of nurse-led interventions for preventing urinary tract infections in older adults in residential aged care facilities: A systematic review**

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## Title page

### Title:

The effectiveness of nurse-led interventions for preventing urinary tract infections in older adults in residential aged care facilities: A systematic review

### Running title:

Preventing urinary tract infections

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### **Author Contributions:**

M-LW and WM were responsible for the study conception and design. M-LW, LP, CJ, LG & WM screened and selected data. M-LW, LP, LG & WM appraised and collated data. M-LW & CJ analysed and interpreted data. MLW & LP drafted the manuscript. M-LW, WM, LG, CJ & LP provided critical review and revisions to the paper. All the authors read and approved the final version of the manuscript.



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## Title

The effectiveness of nurse-led interventions for preventing urinary tract infections in older adults in residential aged care facilities: A systematic review

## Abstract

**Objectives:** To explore the effectiveness of nurse-led interventions to prevent urinary tract infections in older adults living in residential aged care facilities.

**Background:** While most empirical studies focus on the treatment of urinary tract infections, few studies have examined the effectiveness of nurse-led interventions in preventing urinary tract infections.

**Design:** Systematic review

**Methods:** Eight electronic databases were searched for relevant studies published between 2008 to 2018. The inclusion criteria were: (a) a focus on older adults, (b) evaluation of nurse-led interventions, focusing on prevention of urinary tract infection, (c) implemented in residential aged care facilities, and (d) outcomes reported as incidence or prevalence of urinary tract infection. The selected papers were critically appraised using the Mixed Methods Appraisal Tool. The data were analysed with narrative synthesis, and findings were reported following the PRISMA guidelines.

**Results:** A review of 1614 titles and abstracts identified four studies that met the inclusion criteria. Three types of nurse-led interventions were identified: 1) the appointment of advanced practice nurses, 2) those focused on a single specific nursing intervention, and 3) implementation of a multicomponent nursing intervention. All included studies reported at

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least some positive outcomes. However, the included studies were highly heterogeneous and it was impossible to determine the most effective intervention approach.

**Conclusions:** Nurses are leaders in health care and are well-placed to lead prevention of urinary tract infections in residential aged care; however, evidence of the effectiveness of a nurse-led approach is limited. High-quality randomised controlled trials are warranted to address the knowledge gap and advance practice in this area.

**Relevance to Clinical Practice:** When developing an effective nurse-led intervention program, the program should be grounded in nurse-led principles and consider the complex staffing factors to ensure that nurse-led programs are tailored to an effective level.

**Keywords:** Nurse-led interventions; older adults; residential aged care facilities, urinary tract infection.

## 1. Introduction

Urinary tract infections, including catheter-associated urinary tract infections, are one of the most commonly diagnosed infections in residential aged care facilities (RACFs) and account for 12.6% to 50% of all infections in RACFs (Bennett, Johnson, Richards, Smith, & Worth, 2016; Gharbi et al., 2019; Ryan, Gillespie, & Stuart, 2018). The high prevalence of urinary tract infection in RACFs is attributed to a higher rate of cognitive and functional impairments and comorbidities that affect the individual's normal voiding (Jump et al., 2018; Rowe & Juthani-Mehta, 2014). Residents in RACFs often have medical comorbidities such as dementia, diabetes, Parkinson's disease and stroke, which can hinder self-hygiene, contribute to voiding abnormalities (e.g. bladder incontinence), and increase the need for urinary catheterisation in RACFs (Bardsley, 2017; Rowe & Juthani-Mehta, 2014). Additionally, age-related changes often cause decreased feelings of thirst, increased risk of dehydration, and incomplete bladder emptying, which further increase susceptibility to urinary tract infection in residents of RACFs (Leduc, 2014). Urinary tract infection is associated with undesirable clinical outcomes including inappropriate antibiotic usage, emergency department visits, and hospital admissions (Rowe & Juthani-Mehta, 2014), which in turn impose a high financial burden on the healthcare system. For example, the economic burden associated with the treatment of urinary tract infection is estimated to exceed \$2 billion annually in the United States (Foxman, 2014).

Two types of urinary tract infection are commonly diagnosed in older adults: "symptomatic" and "asymptomatic" (Avelluto & Bryman, 2018). Symptomatic urinary tract infection is defined by the presence of urinary tract-specific symptoms with significant bacteriuria, specifically with a quantitative count of  $\geq 10^5$  colony-forming units of bacteria per millilitre (CFU/mL) in one urine specimen (Rowe & Juthani-Mehta, 2014). Clinically, symptomatic urinary tract infection can cause worsening urinary incontinence, urgency, frequency, haematuria, and commonly causes pain in the suprapubic and loin area (Jump et al., 2018). However, older adults may present with atypical symptoms of urinary tract infection such as change in mental status (e.g., confusion or delirium), unusual behaviour changes, and falls (Rowe & Juthani-Mehta, 2013; Wojszel & Toczyńska-Silkiewicz, 2018). These symptoms can impact on residents' general well-being and increase risk of anorexia,

sleep disturbance, fatigue, malaise, and weakness (Finucane, 2017; Jump et al., 2018). Asymptomatic bacteriuria is defined as the presence of bacteria in the urine without any clinical signs or symptoms suggestive of a urinary tract infection (Rowe & Juthani-Mehta, 2014). As a result, the prevention of urinary tract infection in RACFs residents is imperative.

While recognising the high incidence of urinary tract infection in nursing home residents, the management of urinary tract infection in RACFs remains challenging. The evidence indicates that current management of urinary tract infection is heavily reliant on treatment with antibiotics (Bardsley, 2017), and high rates of inappropriate antimicrobial use for urinary tract infection are reported (Eure et al., 2017; Kistler et al., 2017). This has raised concerns about the substantial increase in antimicrobial resistance in residents of RACFs and increases in the cost burden to the healthcare system (Laudisio et al., 2017). On the other hand, non-pharmacological interventions led by Registered Nurses (RNs) have shown promise in preventing urinary tract infection (Durant, 2017).

Registered nurses are health care leaders and hold the greatest accountability for the care of residents in RACFs; as a result, they play a vital role in promoting nurse-led interventions in the advancement of resident wellbeing (Chavez, Dwyer, & Ramelet, 2018; Kiljunen, Välimäki, Kankkunen, & Partanen, 2017). Nurse-led interventions are defined as those where nurses are the principal leading personnel in developing and delivering the intervention, and nurses use their professional expertise to tailor the intervention (Richardson & Cunliffe, 2003). In the context of preventing urinary tract infection, nurse-led programs allow Registered Nurses to act independently in assessing whether residents are at risk of urinary tract infection and if there is a need for pharmacological intervention, or a need for urinary catheterisation (Durant, 2017). The effectiveness of nurse-led interventions in the prevention of catheter-associated urinary tract infection in the acute hospital care setting has been demonstrated (Durant, 2017). However, results from a systematic review in acute hospitals cannot be generalised to RACFs due to the difference in populations and settings. The effectiveness of nurse-led interventions to prevent urinary tract infection in RACFs has received relatively little attention. A systematic review of nurse-led interventions for urinary tract infection in older adults living in RACFs will help identify whether nurse-led interventions can reduce the negative impact on residents' health outcomes, support the development of more comprehensive and coherent nurse-led care, provide evidence to guide

clinical practice in this area, and potentially have a positive financial impact on the health care system.

## **2. Aims**

This review aims to assess the effectiveness of nurse-led interventions to prevent urinary tract infection, including catheter-associated urinary tract infection, in older adults in RACFs. The research questions are:

- 1) What are the effects of nurse-led interventions for preventing urinary tract infection on the incidence and prevalence of urinary tract infection in RACFs?
- 2) To what extent are nurse-led interventions for preventing urinary tract infection effectively preventing catheter-associated urinary tract infection in older adults in RACFs?

## **3. Methods**

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were employed to promote consistency, accountability, integrity, and transparency in the conduct of this review (Moher et al., 2015) (See Supplementary File 1).

### **3.1 Protocol and registration**

This review was registered on the PROSPERO International Prospective Register of Systematic Reviews (registration number: CRD42018096889).

### **3.2 Eligibility criteria**

#### **3.2.1 Types of study design**

Experimental studies including randomised controlled trials, quasi-experimental designs, controlled or uncontrolled before-after studies and time-series studies which have evaluated nurse-led interventions for preventing urinary tract infection or catheter-associated urinary tract infection were considered for inclusion.

#### **3.2.2 Types of participants**

Studies including older adults (65 years of age or over) living in RACFs, regardless of their mobility, cognitive impairment, or presence of urinary catheters, were included. This

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review excluded studies that recruited older adults who were in hospitals or community settings.

### **3.2.3 Types of interventions**

Nurse-led interventions involved one or more elements of the following four broad classifications of interventions to prevent and/or manage urinary tract infection: 1) nursing education interventions for the prevention of urinary tract infection; 2) complementary/alternative therapies for the prevention of urinary tract infection, such as using cranberry products; 3) the early detection of urinary tract infection; and 4) urinary catheter care. Studies that did not focus on nurse-led interventions were excluded.

### **3.2.4 Outcome(s)**

Primary outcomes included the incidence and prevalence of urinary tract infection, including symptomatic or asymptomatic urinary tract infections, asymptomatic bacteriuria, or catheter-associated urinary tract infection; and/or urinary tract infection-associated clinical outcomes such as change in mental status (e.g., confusion or delirium), unusual behaviour changes, falls and occupied bed days for urinary tract infection. The common measures for urinary tract infection in RACFs include, but are not limited to, the following: 1) McGeer criteria (e.g., at least one of the sub-criteria of signs or symptoms, and at least  $10^5$  cfu/mL of no more than 2 species of microorganisms in a voided urine sample); 2) Loeb criteria (e.g., acute dysuria with at least one of the signs or symptoms of urinary tract infection); and 3) dysuria and change in mental status (Rowe & Juthani-Mehta, 2014). Secondary outcomes included minimising inappropriate antibiotic usage, emergency department admission, hospital admission, hospital length of stay, and cost-effectiveness.

## **3.3 Information sources and Search**

Eight electronic databases were searched: CINAHL, Medline, EMBASE, Scopus, ProQuest (Nursing & Allied Health Database), PubMed, Web of Science, and Cochrane Controlled Register of Trials (CENTRAL). To ensure a focus on the contemporary aged care context and the most up-to-date evidence, we chose 2008 as the cut-off for publication year. Hence, the included studies were required to be published after 2008. Each database was searched from January 2008 to December 2018. Medical subject headings (MeSH) and keywords for aged/“older adults”, “urinary tract infections”/ “catheter-related infections” and “nursing home”/“long-term care” were combined to form the search terms (Appendix 1).

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Manual searches of the reference lists of the included studies, as well as searches of relevant systematic reviews, meta-analyses, and clinical guidelines were performed to capture any additional relevant publications. The literature search was limited to papers published in the English language.

### **3.4. Study selection**

#### **3.4.1 Data collection process and extraction**

The titles and abstracts were independently screened by at least two reviewers using the search strategy to identify studies that potentially met the selection criteria. In the initial screening, one reviewer (LP) screened all potentially eligible studies, and the rest of the team members (M-LW, LG, CJ, and WM) each served as second reviewers by screening an equal portion/number of studies. The full texts of potentially eligible studies were retrieved and independently assessed by four review authors (M-LW, LP, LG, and WM) for eligibility against the inclusion and exclusion criteria. The inter-rater agreement among the four reviewers was moderate (Fleiss Kappa= 0.44, 95% CI 0.30~0.56). Any discrepancies were identified and resolved through discussion amongst the four reviewers.

A standardised data extraction form was developed according to the Template for Intervention Description and Replication (TIDieR) (Hoffmann et al., 2014). Three reviewers (M-LW, LG, and LP) independently extracted the data, and any disagreements among the reviewers were resolved via discussion or by consultation with a fourth reviewer (WM). The data extracted included the following specific details: study populations and participant demographics, study settings, study designs and methods, details of nursing interventions and comparisons, outcomes of significance to the review question, results, and limitations.

#### **3.5 Risk of bias in individual studies**

Four reviewers (M-LW, LP, LG, and WM) independently conducted a risk of bias assessment of included studies using the Mixed Methods Appraisal Tool (MMAT) (Hong, Gonzalez - Reyes, & Pluye, 2018). The MMAT was employed because it is a valid and reliable critical appraisal tool designed for systematic mixed methods studies (Hong et al., 2019). It assesses the quality of papers against three core quality criteria for quantitative studies, including randomised controlled trials, non-randomized studies, and quantitative descriptive studies. Any disagreements that arose regarding any studies were resolved by

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discussion where necessary. The consensus risk of bias assessment for all studies is presented in Table 1.

### **3.6 Synthesis of results**

The included studies were heterogeneous in terms of outcome measures, which made a meta-analysis impossible to perform. Hence, results are presented in a narrative summary to provide evidence for current approaches and outcomes concerning nurse-led interventions for preventing urinary tract infection in older adults in RACFs. Explanatory factors were considered, such as the quality of included studies, the population characteristics, the types of interventions, and/or the outcome measures.

## **4. Results**

### **4.1 Study selection**

A total of 3133 records were identified from eight databases, from which 1519 duplicates were removed, and the remaining 1614 titles and abstracts were screened. Of these, 1593 studies were excluded as they did not meet the inclusion criteria, and the remaining 21 full-text studies were reviewed. After review of the full-text studies, another 17 studies were excluded on the basis of (a) the interventions not being led by nurses; (b) the papers not reporting on an intervention study; (c) other types of ineligible publication formats such as conference papers or commentaries; and (d) no available outcome data reported. Hand searching the reference lists of the included studies did not yield any additional studies. As a result, a total of four studies that met the inclusion criteria were included in the review (Lin, 2013; Morrison-Pandy, Ross, Dianxu, & Garand, 2015; Stuart, Orr, Kotsanas, & Gillespie, 2015; van Gaal et al., 2011). The results of the search and selection process are illustrated in Figure 1.

### **4.2 Study characteristics**

The characteristics of the studies, including study design, participants, interventions, and outcomes, are summarised in Table 2. Of the four included studies, one was a cluster-randomised trial (van Gaal et al., 2009), two were quasi-experimental studies (Lin, 2013; Stuart et al., 2015), and one was a descriptive pre-post study (Morrison-Pandy et al., 2015). The included studies were conducted in four countries, including Australia, the Netherlands, Taiwan, and the USA. The characteristics of included studies appeared heterogeneous



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regarding participants' cognitive status, inclusion or exclusion of participants with indwelling urinary catheters, types of interventions, follow-up durations, and outcomes.

#### **4.2.1 Participants**

One study did not provide information about participants, such as age or sample size (Stuart et al., 2015). The included participants were aged care residents with a pooled mean age of 78.9 years ( $SD \pm 10.6$ ). For the remainder of the included studies, the sample sizes ranged from 74 to 392. Of the included studies, only one study assessed participants' cognitive status (Lin, 2013) and one study excluded participants with dementia (van Gaal et al., 2011), while cognitive status was not reported in the other two studies (Morrison-Pandy et al., 2015; Stuart et al., 2015). Similarly, two studies excluded participants with indwelling urinary catheters (Lin, 2013; Morrison-Pandy et al., 2015); however, the presence of urinary catheters was not specified in the other two studies (Stuart et al., 2015; van Gaal et al., 2011). As a result, there was no available evidence with which to address review question two, which specifically sought to examine to what extent nurse-led interventions are effective in preventing catheter-associated urinary tract infection.

#### **4.2.2 Interventions**

The interventions tested in the included studies can be classified into three categories: 1) the appointment of advanced practice nurses ( $n = 2$ ); 2) those focused on single specific nursing interventions ( $n = 1$ ); and 3) implementation of a multicomponent nursing intervention ( $n = 1$ ). Of the two studies that tested the effectiveness of appointing an advanced practice nurse, one study reported on the employment of an infection control Clinical Nurse Consultant (CNC) to drive nursing interventions and provide education to nursing staff and general practitioners in a 3-month follow up program (Stuart et al., 2015). Education was conducted through small lectures and displayed posters on the wards. Details of education included highlighting the importance of using antibiotics appropriately, the management of urinary sepsis in residents, and treatment of multi-drug resistant organisms (MRO) (Stuart et al., 2015). However, the details of the length and frequency of the lectures, and types of material used for the intervention, were not discussed by the authors. The clinical nurse consultant interventions also involved the monitoring of pathology results and liaising with general practitioners and the infectious diseases physician regarding antimicrobial prescription (Stuart et al., 2015).

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The second study reported on the appointment of a full-time Nurse Practitioner (NP) and provided evidence-based supportive management for residents with asymptomatic urinary tract infections (Morrison-Pandy et al., 2015). In this study, the evidence-based supportive nursing interventions included increasing fluid intake and voiding frequency, and/or complementary/alternative therapies, such as drinking cranberry juice for the prevention of urinary tract infection. However, the execution of these evidence-based supportive management strategies was not clearly described. Additionally, the role and activities of the nurse practitioner in pharmacological treatment or assessment of antibiotic usage were not fully described. The duration of the intervention was also not explicitly disclosed (Morrison-Pandy et al., 2015).

The third study focused on a single specific nursing intervention, which aimed to increase residents' daily fluid intake to reduce the incidence of asymptomatic bacteriuria by 6-week follow-up (Lin, 2013). In this study, residents in the intervention group were encouraged by their nurse to increase their daily fluids to greater than 1,500 ml without restriction of beverage type, while residents in the control group continued their usual fluid intake based on their personal preference and without any restriction on volume or type (Lin, 2013). A fluid balance checklist was developed for nurses to record the residents' intake and output in the intervention group (Lin, 2013).

The fourth study tested a multicomponent nursing intervention program, called the patient safety program (SAFE or SORRY?), which was implemented to assess the effect on the incidence of three frequently occurring nursing care-related adverse events specifically, urinary tract infection, pressure ulcers, and falls (van Gaal et al., 2011). This program employed two key nurses to implement nursing interventions which comprised education, patient involvement, and feedback. Education interventions involved: 1) a small-scale educational meeting (1.5 hours) for all nurses, focused on the causes of adverse events, assessment, and prevention of the three adverse events; 2) two case discussions (30 minutes) were held on every ward over a two- to three-month period; and 3) a CD-ROM with educational material for nurses to gain and test their theoretical knowledge (van Gaal et al., 2011). However, the number of times the small educational meetings were held was not reported. In terms of patient involvement, an information leaflet about the prevention of adverse events was provided, with nurses giving verbal information. For the feedback

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component, digital computerised registration and feedback were instigated by the nurses to record participants' daily care, the incidence of adverse events, and to generate feedback on the process and outcomes indicators (van Gaal et al., 2011).

#### **4.2.3 Outcomes**

The primary outcomes for the four included studies were all related to either incidence or prevalence of urinary tract infection; however, the outcome measures varied across studies. Two studies measured the prevalence of asymptomatic urinary tract infection by assessing urine specimens for the presence of one or two bacterial species at  $\geq 10^5$  CFU/ml of urine (Lin, 2013; Morrison-Pandy et al., 2015). One study measured urinary tract infection using the McGeer Criteria and evaluated occupied bed days (Stuart et al., 2015). The final study measured the incidence of urinary tract infection by assessing for bacteriuria with clinical symptoms (van Gaal et al., 2011). None of the included studies reported outcomes for change in mental status (e.g., confusion or delirium), unusual behaviour changes, or falls. For secondary outcomes, two studies reported antibiotic usage (Morrison-Pandy et al., 2015; Stuart et al., 2015). However, there were no studies that measured the secondary outcomes of emergency department admission, hospital admission, hospital length of stay, or cost-effectiveness.

#### **4.3 Risk of bias within studies**

A summary of the quality assessment of the included studies is presented in Table 1. In general, the overall methodological quality of reviewed studies was weak or moderate. The cluster randomised trial (CRT) was evaluated as having a risk of bias for blinding of randomisation as there was no clear description of the allocation process of the clusters and the dropout rate was not sufficiently addressed (van Gaal et al., 2011). Both quasi-experimental studies were assessed as being at potential risk of confounding bias as these two studies seemed not to account for potential confounders in either the study design or analysis (Lin, 2013; Stuart et al., 2015). Other methodological limitations identified from the included studies included: insufficient details of sampling methods for recruiting from the target population (Stuart et al., 2015); limited information on instruments or measurements and study response rate (Morrison-Pandy et al., 2015); and lack of justification for the chosen statistical methods (Morrison-Pandy et al., 2015). However, all included studies provided a

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clear statement of aims and appropriate data collection methods to address their research questions.

#### **4.4 Synthesis of results**

In order to answer the research questions, included studies were synthesised according to types of nurse-led interventions and outcome measures. For each study, results are presented in Table 2. However, due to the relative lack of currently available evidence regarding the effectiveness of nurse-led interventions for reducing catheter-associated urinary tract infection in older adults in RACFs, this review is limited to only addressing review question one.

##### **4.4.1 Primary outcomes: incidence/prevalence of urinary tract infection, and associated clinical outcomes**

###### **4.4.1.1 Effectiveness of appointing advanced practice nurses on primary outcomes**

Two studies reported the effects of appointing advanced practice nurses either on prevalence of asymptomatic urinary tract infection or urinary tract infection-associated clinical outcomes. Stuart et al. (2015) showed statistically significant effects of the implementation of a clinical nurse consultant-led antimicrobial stewardship intervention at three-months follow-up with reduction in occupied bed days for urinary tract infection ( $p < .001$ ). Similarly, Morrison-Pandy et al. (2015) reported statistically significant improvements for managing asymptomatic urinary tract infections after employing a nurse practitioner. They reported positive intervention effects, with increases in fluid intake ( $p < .001$ ), toileting frequency ( $p < .001$ ), and cranberry juice consumption ( $p < .05$ ). However, the prevalence of asymptomatic urinary tract infections was not clearly reported (Morrison-Pandy et al., 2015). Therefore, it was not possible to evaluate the effectiveness of this intervention in reducing asymptomatic urinary tract infections.

###### **4.4.1.2 Effectiveness of using single nursing intervention on primary outcomes**

Interesting findings were noted in Lin's (2013) study. The prevalence of asymptomatic urinary tract infection statistically significantly decreased between baseline and six-week follow-up ( $p < .001$ ) for both the intervention and control groups. However, the intervention group appeared to have a significantly greater improvement in daily fluid intake ( $p < .001$ ) compared to the control group, even though there was no statistically significant difference

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between intervention and control groups on the prevalence of asymptomatic urinary tract infection (Lin, 2013).

#### **4.4.1.3 Effectiveness of implementing a multicomponent nursing intervention on primary outcomes**

The results from the one study that tested the implementation of a multicomponent nursing intervention showed a limited effect on the incidence of urinary tract infections (van Gaal et al., 2011). van Gaal et al. (2011) reported that the comprehensive patient safety program (SAFE or SORRY?) did not show significant differences between intervention and control groups in the incidence of urinary tract infections (rate ratio = 0.85, 95% CI: 0.43-1.67). Since the confidence interval includes “1”, there is insufficient evidence to conclude that the intervention and usual care groups are statistically significantly different in terms of incidence of urinary tract infection following the intervention.

#### **4.4.2 Secondary outcomes: antibiotic usage and fluid intake**

In the included studies, two studies assessed the impact of nurse-led interventions on prescription and use of antibiotics. One study reported the implementation of a clinical nurse consultant-led antimicrobial stewardship intervention led to a statistically significant reduction in antibiotic usage ( $p < .001$ ) (Stuart et al., 2015); whereas there was no statistically significant difference in antibiotic prescribing rates found in the study that compared pre- and post-employment of a nurse practitioner (Morrison-Pandy et al., 2015). It is noted that no specific pharmacology-related aspects of nursing intervention were included in this study, which might have influenced the study results.

Two studies reported significant improvements in fluid intake as compared to usual care (Lin, 2013), or without control groups (Morrison-Pandy et al., 2015). Both studies used increasing fluid intake as supportive strategies to reduce UTI in residents living in RACFs. Lin (2013) increased daily fluids to greater than 1500ml without restriction of the type of fluids as the intervention, while Morrison-Pandy et al (2015) combined both pharmacological (antibiotic) and non-pharmacological strategies of increasing fluid intake or drinking cranberry juice.

## **5. Discussion**

This systematic review identified four eligible papers reporting on the effectiveness of nurse-led interventions for preventing urinary tract infections in older adults in RACFs. The findings identified three types of nurse-led interventions, including 1) the appointment of advanced practice nurses, 2) those focused on a single specific nursing intervention, and 3) implementation of multicomponent nursing intervention. These three intervention categories incorporated aspects of nursing education interventions and/or complementary/alternative therapies (e.g. using cranberry juice) for the prevention of urinary tract infections. In the four included studies, one cluster-randomised controlled trial (van Gaal et al., 2011) and one quasi-experimental pre-post study (Lin, 2013) reported insignificant differences between control and intervention groups. The other two non-randomised controlled trial studies (Morrison-Pandy et al., 2015; Stuart et al., 2015) and the quasi-experimental pre-post study (Lin, 2013) showed within-group differences in urinary tract infection related outcomes, including reductions in asymptomatic bacteriuria, improvements in asymptomatic bacteriuria management, reductions in antibiotic usage, increasing in fluid intake and fewer occupied bed days related to urinary tract infection. These findings indicate that existing studies show potential for nurse-led interventions to improve urinary tract infection related outcomes. However, the included studies were highly heterogeneous in terms of study design, participants, types of nursing interventions, follow-up durations, and outcome measures, which made it difficult to draw conclusions about the most effective interventions. As a result, a meta-analysis was impossible to conduct because of these heterogeneities. Additionally, there was no evidence found concerning the secondary outcomes of emergency department admission, hospital admission, hospital length of stay, or cost effectiveness.

The methodological quality of the included studies appeared to be weak to moderate. Currently, the existing available evidence for nurse-led intervention in preventing urinary tract infections or catheter-associated urinary tract infections in older adults in RACFs is scarce and is predominantly based on the pilot (Lin, 2013) and feasibility studies (Morrison-Pandy et al., 2015; Stuart et al., 2015). These studies tended to have smaller sample sizes, no randomisation, no control group, and lack of clarity around outcome measures. Moreover, limited studies were controlling for potentially confounding variables. Despite the methodological limitations, this review offers some valuable findings to inform future studies

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in the context of designing and developing nurse-led interventions for preventing urinary tract infections in older adults in RACFs.

This review shows that it is not yet possible to conclusively state that appointing advanced practice nurses can achieve better results in terms of preventing urinary tract infections in RACFs (Morrison-Pandy et al., 2015; Stuart et al., 2015). However, this result should be interpreted with caution as the details of the protocols for the nurse-led interventions were unclear in the included papers and the study designs were less rigorous. Richardson and Cunliffe (2003) suggest that, when considering the development of a nurse-led intervention protocol, a few key principles need to be considered such as that the intervention should be able to strengthen leadership, and advance and change practice, with nurses offering expert input and collaborating with other disciplines to achieve better services.

On this note, it appears that Stuart et al.'s (2015) interventions were more closely aligned with the principles of the nurse-led intervention, in that they reinforced the clinical nurse consultant's leadership, and focused on collaboration between the clinical nurse consultant and other interdisciplinary health professionals such as general practitioners and infectious disease physicians. The results of their study highlighted that the role of nursing leadership is particularly important in this study context because nurses are recognised as leaders in health care, and effective leadership is a major part of nursing care (Debono et al., 2016; Scully, 2015). Wong, Cummings and Ducharme (2013) state that effective leadership was directly associated with better clinical outcomes and fewer complications including lower rates of urinary tract infections. Hence, effective leadership plays an essential role in nurse-led intervention as it acts as an alliance-builder to coordinate and motivate residents, family and care teams to deliver safe and high-quality care, including preventing urinary tract infections (Debono et al., 2016).

With regard to studies using a single nursing intervention (Lin, 2013) and multicomponent nursing interventions (van Gaal et al., 2011), both studies reported positive effects on some outcomes. In the single nursing intervention program that focused on increasing daily fluid intake, the prevalence of asymptomatic bacteriuria was statistically significantly decreased. The nursing strategy to prevent urinary tract infections by actively promoting and monitoring oral hydration is supported by current evidence (Cortes-Penfield, Trautner, & Jump, 2017). For the multicomponent nursing interventions, van Gaal et al.

(2011) found that the incidence of urinary tract infections in the intervention group was not significantly reduced. The education component of the program was designed for all nurses (van Gaal et al., 2011). However, other influential factors such as the availability and levels of nursing staff might have impacted on the study outcome.

Bonner (2017) argues that inadequate staffing, either in the number of nursing staff or a mix of nursing staff, leads to increased rates of adverse events, including urinary tract infections. Furthermore, Henderson, Willis, Xiao and Blackman (2017) surveyed the causes of missed care in RACFs in three Australian states. They revealed that the main reasons for missed care are staffing shortages and challenges in meeting residents' complex health care needs as there are fewer skilled nurses to meet this request (Henderson et al., 2017). Since the quality and safe care of residents in RACFs is often determined by the levels of nursing staffing and the mix of nursing staff skills (Willis et al., 2016), future studies focusing on nurse-led intervention to prevent urinary tract infections need to factor in challenges associated with the complexity of staffing issues, such as inadequate staffing and skill mix of nursing staff. Taking these factors into account may help facilitate the tailoring of specific education programs for different levels of nurses.

In comparing the present review with previous relevant systematic reviews of interventions to prevent or manage urinary tract infections, three previous systematic reviews were identified. These examined: 1) the prevention of catheter-associated urinary tract infections and improvements in catheter care in nursing homes by implementing clinical guidelines (Gould, Gaze, Drey, & Cooper, 2017); 2) interventions to reduce urinary tract infections in nursing home residents (Meddings et al., 2017); and 3) the prevention of catheter-associated urinary tract infections using nurse-driven protocols in acute hospital settings (Durant, 2017). Of these three reviews, only one review adopted a nurse-led approach; however, the review was based on evidence from acute healthcare settings (Durant, 2017).

Findings from the other two reviews (Gould et al., 2017; Meddings et al., 2017) are congruent with the present review in that it was not possible to draw a firm conclusion regarding the effect of interventions on urinary tract infections due to the diversities of interventions and lack of clarity of outcome measures, which also made a meta-analysis impossible to carry out. Only Durant (2017) reported that nurse-driven protocols appeared to



have positive impacts on the prevalence of catheter-associated urinary tract infections, and these were strong clinical predictors of reduction of indwelling-urinary catheter utilization in acute healthcare settings. This finding might suggest that the implementation of nurse-led interventions may have the same effect of reducing urinary tract infections in older adults in RACFs.

A few limitations are identified in this review. Firstly, there were limited available studies for inclusion in this review, and as a result, any conclusions about the effectiveness of nurse-led interventions to improve urinary tract infections in older adults in RACFs should be treated with caution. Secondly, there was a high degree of methodological heterogeneity among the included studies as well as a several of methodological limitations and weaknesses, which in turn impact on the internal validity of the findings. Thirdly, this review only included studies published in English, which increases the risk of publication bias as unpublished studies or those studies published in non-English languages were excluded. Furthermore, it is noted that there is limited evidence on measuring urinary tract infection associated outcomes such as quality of life, emergency department admission, hospital admission, and cost-effectiveness. Finally, this review is unable to provide a summary of evidence on the effectiveness of nurse-led interventions for catheter-associated urinary tract infections in older adults in RACFs due to insufficient studies in the field.

## 6. Conclusion

This systematic review evaluates and synthesises the currently available evidence on the effectiveness of nurse-led interventions for preventing urinary tract infections in older adults in RACFs. This review reveals that there is little published evidence in this field. Only four studies met the inclusion criteria, and these were predominantly pilot and feasibility studies. Preliminary evidence from the included studies demonstrated positive effects on some outcomes, such as reducing the prevalence of asymptomatic urinary tract infection or incidence of urinary tract infections and reducing antibiotic utilisation. However, the effectiveness of nurse-led interventions on urinary tract infections was unable to be determined due to the heterogeneous nature of the included studies and methodological limitations. Hence, there is a compelling need to develop effective nurse-led interventions for preventing urinary tract infections that implement nurse-led principles so that the

interventions are specifically tailored to older adults in RACFs. Additionally, in order to promote evidence-based practice, future research in this field should be grounded in more rigorous study designs such as high quality randomised controlled trials to enhance the methodological integrity and generalisability of study findings.

## **7. Relevance to Clinical Practice**

Urinary tract infections are the most common type of infection in older adults, especially in RACFs (Rowe & Juthani-Mehta, 2014). This review highlights a lack of empirical evidence supporting the use of nurse-led interventions to prevent urinary tract infections in RACFs effectively. Only four studies met the systematic review inclusion criteria, indicating that the development and evaluation of nurse-led interventions in this context is still in its infancy. Additionally, this review highlights a need for well-designed and robust studies such as high quality randomised controlled trials to improve methodological quality. Ideally, high quality randomised controlled trials should use best-practice randomisation methods, clearly defined outcome measures and/or standardised outcome measures, have long-term follow-up, ensure control for confounding variables such as placebo, duration of care, and adjust for potentially confounding variables in study design. Additionally, broader clinical outcomes related to urinary tract infections should be explored such as hospital admission, hospital length of stay, the cost-effectiveness of nurse-led intervention and quality of life.

When developing an effective nurse-led intervention program for preventing urinary tract infections in older adults in the complex RACF context, a few recommendations are highlighted. Firstly, an effective nurse-led intervention program should be grounded in nurse-led principles, especially emphasising the role of leadership (Richardson & Cunliffe, 2003). Registered Nurses, as frontline healthcare workers, play an important role in assessing the older adult's health condition to assist in the early detection of urinary tract infections, which in turn can promote accurate diagnosis and treatment of urinary tract infections. As a result, this can contribute to appropriate antimicrobial utilisation and cost-effective medical care (Schulz et al., 2016). Secondly, the aged care sector may benefit from establishing partnerships with education providers such as universities to work together to develop an effective nurse-led program to achieve optimum outcomes for preventing urinary tract infections (Barnett, Morett, & Howard, 2015).

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Finally, an effective nurse-led program must be led and implemented by appropriate staff. However, staffing remains a challenge in the aged care sector (Willis et al., 2016). For example, the Australian government has been urged to review and undertake policy reform concerning establishing minimum safe RN staffing levels, RN and unregulated health care worker ratios, and appropriate skills and ‘skill-mix’ in all health care settings (Australian Department of Health, 2018). Significant evidence over the years has demonstrated that engaging an adequate number of RNs relative to the number of unregulated health care workers results in minimisation of adverse events and cost of complications, and an improvement in the general quality of aged care (Australian College of Nursing, 2019; Henderson et al., 2017). The aged care management leaders should take these staffing factors into account to ensure that nurse-led education programs are tailored to the appropriate level and safe and high-quality care is delivered.

## References

- Australian College of Nursing. (2019). Regulation of the unregulated health care: workforce across the health care system: a white paper by ACN 2019, ACN, Canberra.
- Australian Department of Health. (2018). *A matter of care Australia's aged care workforce strategy, aged care workforce strategy taskforce*, Retrieved from [https://agedcare.health.gov.au/sites/default/files/documents/09\\_2018/aged\\_care\\_workforce\\_strategy\\_report.pdf](https://agedcare.health.gov.au/sites/default/files/documents/09_2018/aged_care_workforce_strategy_report.pdf)
- Avelluto, G. D., & Bryman, P. N. (2018). Asymptomatic bacteriuria vs. symptomatic urinary tract infection: identification and treatment challenges in geriatric care. *Urologic Nursing*, 38(3), 129-143. <http://dx.doi.org/10.7257/1053816X.2018.38.3.129>
- Bardsley, A. (2017). Diagnosis, prevention and treatment of urinary tract infections in older people. *Nursing Older People*, 29(2), 32-38. <http://dx.doi.org/10.7748/nop.2017.e884>
- Barnett, K., Morett, C., & Howard, S. (2015). *TRACS to the future - national evaluation of Teaching and Research Aged Care Service (TRACS) models: final report*. Retrieved from <https://agedcare.health.gov.au/tracs-to-the-future-national-evaluation-of-teaching-and-research-aged-care-services-tracs-models-final-report>
- Bennett, N., Johnson, S., Richards, M., Smith, M., & Worth, L. (2016). Infections in Australian aged-care facilities: evaluating the impact of revised McGeer Criteria for surveillance of urinary tract infections, 37(5), 610-612. *Infection Control & Hospital Epidemiology*, 37(5), 610-612. <https://doi.org/10.1017/ice.2016.7>
- Bonner, R. (2017). ANMF'S aged care staffing and skill mix project. *Australian Nursing and Midwifery Journal*, 24(9), 28-33.
- Chavez, K. S., Dwyer, A. A., & Ramelet, A-S. (2018). International practice settings, interventions and outcomes of nurse practitioners in geriatric care: a scoping review. *International Journal of Nursing Studies*, 78, 61-75. <https://doi.org/10.1016/j.ijnurstu.2017.09.010>
- Cortes-Penfield, N. W., Trautner, B. W., & Jump, R. L. (2017). Urinary tract infection and asymptomatic bacteriuria in older adults. *Infectious Disease Clinics of North America*, 31(4), 673-688. <http://dx.doi.org/10.1016/j.idc.2017.07.002>

- Debono, D., Travaglia, J.F., Dunn, A. G., Thoms, D., Hinchcliff, R., Plumb, J., ...Braithwaite, J. (2016). Strengthening the capacity of nursing leaders through multifaceted professional development initiatives: a mixed method evaluation of the 'Take The Lead' program. *Collegian*, 23(1), 19-28. <https://doi.org/10.1016/j.colegn.2014.09.005>
- Durant, D. J. (2017). Nurse-driven protocols and the prevention of catheter-associated urinary tract infections: a systematic review. *American Journal of Infection Control*, 45(12), 1331-1341. <https://doi.org/10.1016/j.ajic.2017.07.020>
- Eure, T., LaPlace, L. L., Melchreit, R., Maloney, M., Lynfield, R., Whitten, T., ...Thompson ND. (2017). Measuring antibiotic appropriateness for urinary tract infections in nursing home residents. *Infection Control and Hospital Epidemiology*, 38(8), 998-1001. <https://doi.org/10.1017/ice.2017.96>
- Finucane, T. E. (2017). "Urinary tract infection" - requiem for a heavyweight. *Journal of The American Geriatrics Society*, 65(8), 1650-1655. <https://doi.org/10.1111/jgs.14907>
- Foxman, B. P. (2014). Urinary tract infection syndromes. *Infectious Disease Clinics of North America*, 28(1), 1-13. <http://dx.doi.org/10.1016/j.idc.2013.09.003>
- Gharbi, M., Drysdale, J. H., Lishman, H., Goudie, R., Molokhia, M., Johnson, A. P., ...Paul, A. (2019). Antibiotic management of urinary tract infection in elderly patients in primary care and its association with bloodstream infections and all cause mortality: population based cohort study. *British Medical Journal*, 364, 1-13. <http://dx.doi.org/10.1136/bmj.l525>
- Gould, D., Gaze, S., Drey, N., & Cooper, T. (2017). Implementing clinical guidelines to prevent catheter-associated urinary tract infections and improve catheter care in nursing homes: systematic review. *American Journal of Infection Control*, 45(5), 471-476. <https://doi.org/10.1016/j.ajic.2016.09.015>
- Henderson, J., Willis, E., Xiao, L., & Blackman, I. (2017). Missed care in residential aged care in Australia: an exploratory study. *Collegian*, 24(5), 411-416. <https://doi.org/10.1016/j.colegn.2016.09.001>
- Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., ...Michie, S. (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ: British Medical Journal*, 348, 1687-1699. <https://doi.org/10.1136/bmj.g1687>

- Hong, Q. N., Gonzalez-Reyes, A., & Pluye, P. (2018). Improving the usefulness of a tool for appraising the quality of qualitative, quantitative and mixed methods studies, the Mixed Methods Appraisal Tool (MMAT). *Journal of Evaluation in Clinical Practice*, 24(3), 459-467. <https://doi.org/10.1111/jep.12884>
- Hong, Q. N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., ... Vedel, I. (2019). Improving the content validity of the mixed methods appraisal tool: a modified e-Delphi study. *Journal of Clinical Epidemiology*, 111, 49-59. <https://doi.org/10.1016/j.jclinepi.2019.03.008>
- Jump, R. L., Crnich, C. J., Mody, L., Bradley, S. F., Nicolle, L. E., & Yoshikawa, T. T. (2018). Infectious diseases in older adults of long-term care facilities: update on approach to diagnosis and management. *Journal of The American Geriatrics Society*, 66(4), 789-803. <https://doi.org/10.1111/jgs.15248>
- Kiljunen, O., Välimäki, T., Kankkunen, P & Partanen, P. (2017). Competence for older people nursing in care and nursing homes: an integrative review. *International Journal of Older People Nursing*, 12(3), 1-10. <https://doi.org/doi:10.1111/opn.12146>
- Kistler, C. E., Beeber, A., Becker-Dreps, S., Ward, K., Meade, M., Ross, B., & Sloane, P. D. (2017). Nursing home nurses' and community-dwelling older adults' reported knowledge, attitudes, and behavior toward antibiotic use. *BMC Nursing*, 16 (1), 1-7. <http://dx.doi.org/10.1186/s12912-017-0203-9>
- Laudisio, A., Marinosci, F., Gemma, A., Bartoli, I.R., Montenegro, N., & Incalzi, R. A. (2017). The burden of comorbidity is associated with antibiotic resistance among institutionalized elderly with urinary infection: a retrospective cohort study in a single Italian nursing home between 2009 and 2014. *Microbial Drug Resistance*, 23(4), 500-506. <https://doi.org/10.1089/mdr.2016.0016>
- Leduc, A. (2014). Reducing the treatment of asymptomatic bacteriuria in seniors in a long-term care facility. *The Canadian Nurse*, 110(7), 25-30.
- Lin, S-Y. (2013). A pilot study: fluid intake and bacteriuria in nursing home residents in southern Taiwan. *Nursing Research*, 62(1), 66-72. <https://doi.org/10.1097/NNR.0b013e31826901d5>
- Meddings, J., Saint, S., Krein, S. L., Gaies, E., Reichert, H., Hickner, A., ...Mody, L. (2017). Systematic review of interventions to reduce urinary tract infection in nursing home

- residents. *Journal of Hospital Medicine*, 12(5), 356-368. <https://doi.org/10.12788/jhm.2724>
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of Clinical Epidemiology*, 62(10), 1006-1012. <http://dx.doi.org/10.1016/j.jclinepi.2009.06.005>
- Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ...Group, P-P. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, 4(1), 1-25. <http://dx.doi.org/10.1186/2046-4053-4-1>
- Morrison-Pandy, L. E., Ross, C. A., Dianxu, R., & Garand, L. (2015). The role of the Nurse Practitioner and asymptomatic urinary treatments. *Journal for Nurse Practitioners*, 11(9), 903-906. <https://doi.org/10.1016/j.nurpra.2015.06.008>
- Richardson, A., & Cunliffe, L. (2003). New horizons: the motives, diversity and future of 'nurse led' care. *Journal of Nursing Management*, 11(2), 80-84. <https://doi.org/10.1046/j.1365-2834.2002.00364.x>
- Rowe, T. A., & Juthani-Mehta, M. (2013). Urinary tract infection in older adults. *Aging Health*, 9(5), 519-528. <http://dx.doi.org/10.2217/ahe.13.38>
- Rowe, T. A., & Juthani-Mehta, M. (2014). Diagnosis and management of urinary tract infection in older adults. *Infectious Disease Clinics of North America*, 28(1), 75-89. <http://dx.doi.org/10.1016/j.idc.2013.10.004>
- Ryan, S., Gillespie, E., & Stuart, R. L. (2018). Urinary tract infection surveillance in residential aged care. *American Journal of Infection Control*, 46(1), 67-72. <https://doi.org/10.1016/j.ajic.2017.07.002>
- Scully, N. J. (2015). Leadership in nursing: the importance of recognising inherent values and attributes to secure a positive future for the profession. *Collegian*, 22(4), 439-444. <https://doi.org/10.1016/j.colegn.2014.09.004>
- Stuart, R. L., Orr, E., Kotsanas, D., & Gillespie, E. E. (2015). A nurse-led antimicrobial stewardship intervention in two residential aged care facilities. *Healthcare Infection*, 20(1), 4-6. <https://doi.org/10.1071/HI14016>
- van Gaal, B. G., Schoonhoven, L., Hulscher, M. E., Mintjes, J. A., Borm, G. F., Koopmans, R. T., & van Achterberg, T. (2009). The design of the SAFE or SORRY? study: a cluster

randomised trial on the development and testing of an evidence based inpatient safety program for the prevention of adverse events. *BMC Health Services Research*, 9, 58. <https://doi.org/10.1186/1472-6963-9-58>

van Gaal, B. G., Schoonhoven, L., Mintjes, J. A., Borm, G. F., Hulscher, M. E., Defloor, T., ...van Achterberg, T. (2011). Fewer adverse events as a result of the SAFE or SORRY? programme in hospitals and nursing homes. part I: primary outcome of a cluster randomised trial. *International Journal of Nursing Studies*, 48(9), 1040-1048. <https://doi.org/10.1016/j.ijnurstu.2011.02.017>

Willis, E., Price, K., Bonner, R., Henderson, J., Gibson, T., Hurley, J., ...Currie, T. (2016) *Meeting residents' care needs: a study of the requirement for nursing and personal care staff*. Retrieved from [http://www.anmf.org.au/documents/reports/National\\_Aged\\_Care\\_Staffing\\_Skills\\_Mix\\_Project\\_Report\\_2016.pdf](http://www.anmf.org.au/documents/reports/National_Aged_Care_Staffing_Skills_Mix_Project_Report_2016.pdf)

Wojszel, Z. B., & Toczyńska-Silkiewicz, M. (2018). Urinary tract infections in a geriatric sub-acute ward-health correlates and atypical presentations. *European Geriatric Medicine*, 9(5), 659-667. <https://doi.org/10.1007/s41999-018-0099-2>

Wong, C. A., Cummings, G. G., & Ducharme, L. (2013). The relationship between nursing leadership and patient outcomes: a systematic review update. *Journal of Nursing Management*, 21(5), 709-724. <https://doi.org/10.1111/jonm.12116>



**Table 1****Summary of the quality assessment of the included studies using the Mixed Methods Appraisal Tool (MMAT)**

Types of study design	Methodological quality criteria	Lin 2013	Morrison 2015	Stuart 2015	van Gaal 2011
<b>Screening</b>	Are there clear qualitative and quantitative research questions (or objectives*), or a clear mixed methods question (or objective*)?	√	√	√	√
	Do the collected data allow to address the research question (objective)?	√	√	√	√
<b>1. Quantitative randomised controlled trials</b>	1.1. Is randomisation appropriately performed?	-	-	-	?
	1.2. Are the groups comparable at baseline?	-	-	-	?
	1.3. Are there complete outcome data?	-	-	-	?
	1.4. Are outcome assessors blinded to the intervention provided?	-	-	-	?
	1.5. Did the participants adhere to the assigned intervention?	-	-	-	√
<b>2. Quantitative non-randomised studies</b>	2.1. Are the participants representative of the target population?	√	-	?	-
	2.2. Are measurements appropriate regarding both the outcome and intervention (or exposure)?	√	-	√	-
	2.3. Are there complete outcome data?	√	-	√	-

<b>3. Quantitative descriptive studies</b>	2.4. Are the confounders accounted for in the design and analysis?	X	-	X	-
	2.5. During the study period, is the intervention administered (or exposure occurred) as intended?	√	-	√	-
	3.1. Is the sampling strategy relevant to address the research question?	-	√	-	-
	3.2. Is the sample representative of the target population?	-	√	-	-
	3.3. Are measurements appropriate?	-	X	-	-
	3.4. Is the risk of nonresponse bias low?		?		
	3.4. Is the statistical analysis appropriate to answer the research question?	-	X	-	-
Note: “√” = yes; “X” = no; “?” = cannot tell; “-” = not applicable					

**Table 2**  
**Characteristics and results of the included studies**

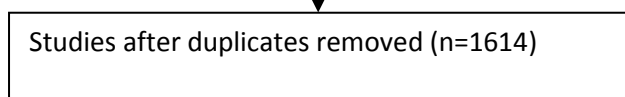
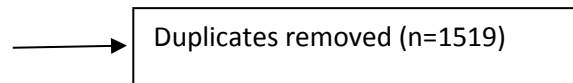
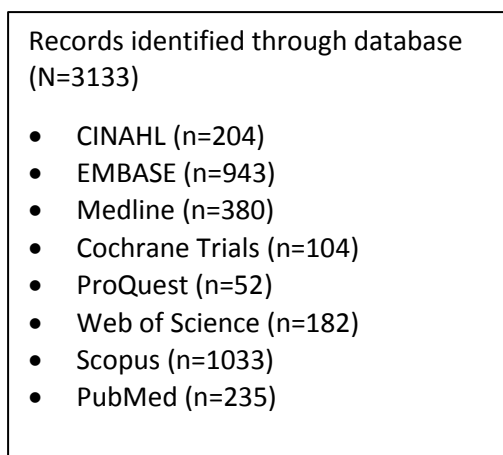
Authors/Year/ Country	Study design	Participants					Interventions		Outcomes		Results
		Sample size	Age	Setting	Cognitive status	Presence of urinary catheters	Intervention and comparator		Primary/outcome measures	Secondary	
Lin (2013)/ Taiwan	Quasi-experimental pre-post study	INT: n=30  CON: n=44	75.2±11.9 years	Nursing homes	SPMSQ: 5.9±3.5 (range 5-7)  indicated moderate intellectual impairment	No (excluded)	INT: Increase fluid intake (6-week follow up). Increase daily fluids to greater than 1500 ml (type of fluid was not restricted), for duration of six weeks. Nurses completed the fluid balance checklist.  CON: Maintained fluid. Consume fluid based on participant's preference without any restriction on volume or types.		The prevalence of asymptomatic bacteriuria (ASB): Urine specimens (culture): presence of one or two bacterial species at $\geq 10^5$ CFU/ml of urine	Daily fluid intake, Barthel Index, Mini Nutritional Assessment (MNA)	Prevalence of ASB was significantly reduced between baseline and 6-week follow-up ( $p < .001$ ) for both groups of participants.  No significant difference between pre- and post-intervention in asymptomatic bacteriuria.  Compared to the control group, the intervention group had significantly greater improvement on daily fluid intake ( $p < .001$ ).

Morrison-Pandy et al. (2015)/USA	Pre-post descriptive study	N=89	79.6±8.07 (range 66-90) years	Long-term care facilities	Not reported	No (excluded)	Employment of a nurse practitioner (NP).  INT: NPs provided evidence-based supportive strategies including increasing fluid intake and voiding frequency, and/or drinking cranberry juice. Specific nursing activities related to pharmacology were not reported.	Asymptomatic urinary tract infection (aUTI)/measurement: bacteriuria present ( $\geq 10^5$ CFU/ml) for 2 consecutive urine samples and no clinical symptoms	Antibiotic usage	Post-employment of a NP, significantly greater improvement in management of aUTI with the following supportive strategies: increased fluids (p<.001), frequent toileting (p<.001), and cranberry juice (p<.05).  No significant differences in antibiotic prescribing rates from pre- to post-employment of the NP.
Stuart et al. (2015)/Australia	Quasi-experimental pre-post study	Not reported	Not reported	Residential aged care facilities (RACFs) and hostel	Not reported	Not reported	A nurse-led antimicrobial stewardship intervention (3-month follow up).  INT: Clinical Nurse Consultant (CNC) led the education of nursing staff and GPs, monitored the pathology results, liaised with prescribing GP and infectious disease physician. The education program highlight the importance of using antibiotics appropriately i.e. not treating asymptomatic bacteriuria, management of urinary sepsis; treatment of multi-drug resistant organisms (MRO).	UTI: Occupied bed days (OBDs)  UTI was measured using McGeer criteria	Antibiotic usage (total days of antimicrobials prescribed)	Post-CNC led intervention there was a statistically significant decrease in OBDs for UTI (p<.001).  Antibiotic usage was significantly reduced (p < .001)
van Gaal et al. (2011)/Netherlands	Cluster randomised trial	INT: n=196	INT: 80±10.9 years	Nursing homes	No included dementia	Not reported	Patient safety program (SAFE or SORRY?) (9-month follow-up)	Incidence of adverse events (falls, pressure ulcers, and UTIs) per	None	No significant between-group difference in the incidence of UTI (rate ratio=0.85, 95%

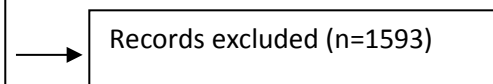
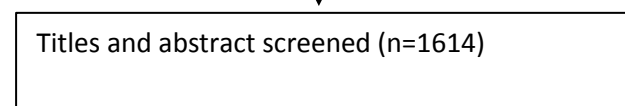
CON: n=196	CON: 79±10.5 years	INT: 1) Education: small-scale educational meetings for all nurses (1.5hr), two case discussions on every ward (30min), and CD-ROM with education material (causes of adverse events, assessment of patients at risk and prevention of adverse events) and a test with feedback; 2) Patient involvement: information leaflet for the prevention of adverse events, nurse to provide oral information to patient at risk for the specific adverse event; and 3) Feedback: nurses register the patient's daily care and the presence or absence of an adverse event.  CON: Usual care.	patient-week.  UTI was measured by bacteriuria with clinical symptoms (frequent urinating, pain while urinating, abdominal pain, fever, delirium, urinary incontinence).	CI: 0.43-1.67).  Fewer pressure ulcers per patient-week (rate ratio=0.34, 95% CI: 0.15-0.76) and falls per patient-week (rate ratio=0.63, 95% CI: 0.35-1.16) for intervention group compared to control.  Reduced incidence of adverse events (rate ratio=0.67, 95% CI: 0.47-0.97) for the intervention group compared to control.
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Abbreviation: ASB = asymptomatic bacteriuria; aUTI = Asymptomatic urinary tract infection; CI = confidence interval; CFU = colony forming units; CNC = clinical nurse consultant; CON = control group; GP = general practitioner; INT = intervention group; NP = nurse practitioner; OBD = occupied bed days; SPMSQ = Short Portable Mental Status Questionnaire; UTI = urinary tract infection.

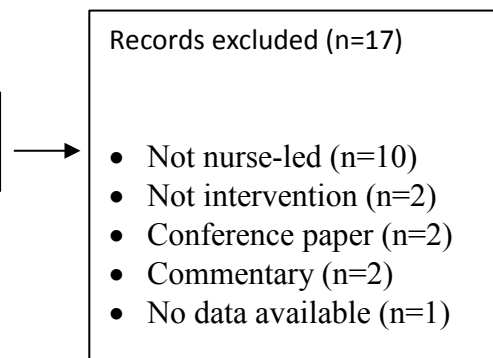
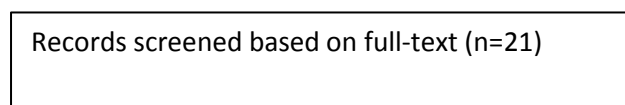
Identification



Screening



Eligibility



Included

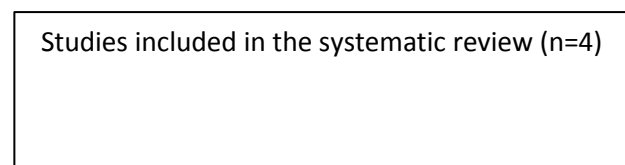


Fig. 1. PRISMA flow diagram.